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Original research

Staple line as a cause of unusual early internal hernia after appendectomy

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ABSTRACT

The use of mechanical stapling devices in laparoscopic appendectomies has become a common practice. Occasionally, the retained staples have been described to cause adhesions that might result in bowel obstruction. Early bowel obstruction after routine abdominal surgery should be closely investigated and might warrant early re-exploration. We present a rare case of small bowel obstruction caused by a staple line adhesive band one week after appendectomy.

A 46-year-old female underwent laparoscopic appendectomy for uncomplicated appendicitis. A linear endoscopic stapling device was utilized during the procedure. The patient was discharged without complication. One week later, the patient presented to the emergency room for abdominal pain and she was discharged after adequate pain control. Several hours later she returned with similar symptoms, and she was diagnosed with distal small bowel obstruction by computed tomography scan. During the diagnostic laparoscopy there was an internal hernia through a defect created by the appendiceal staple line and the adjacent small bowel mesentery. After reduction of the hernia, the small bowel venous drainage improved, and no intestinal resection was necessary. The offending staple was removed and the staple line covered with omentum.

The patient had complete resolution of symptoms and she was discharged the following day. No perioperative complications occurred.

Mechanical staplers are routinely used in laparoscopic appendectomy.

The staple line should be inspected at the end of the procedure to confirm the absence of free, unformed staples that can generate adhesions and postoperative complications.

1. Introduction

Surgical approach of appendectomy has evolved in the past decade. Minimally invasive techniques offer prompt recovery, fewer infections, and early discharge of patients [1]. This results in a safe and effective approach [2]. The appendiceal stump is frequently closed with staples. Few published reports describe complications resulting from staple closure of the appendix. We report an uncommon case of early small bowel obstruction resulting from adhesions to the appendiceal stump staple line.

2. Case description

A 46-year-old female underwent a laparoscopic appendectomy for simple uncomplicated appendicitis. A linear endoscopic stapling device was utilized during the procedure, and a small umbilical hernia was also primarily repaired. The recovery was unremarkable and the patient was discharged the following day. One week postoperatively, she presented in the emergency department with progressively worsening back and supra-umbilical pain. Clinically, her abdomen was benign and the pain was attributed to the

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umbilical hernia repair. The patient was discharged with pain control. Six hours later she presented with nausea, vomiting, and abdominal cramping. Her laboratory evaluation revealed minimal leukocytosis and metabolic acidosis. A contrast computed tomography (CT) scan showed a partial obstruction at the terminal ileum with surrounding mesenteric edema (Fig. 1).

After appropriate fluid resuscitation, the patient was taken to the operating room for exploratory laparoscopy. The access to the abdominal cavity was obtained by periumbilical open Hasson technique. Two additional 5-mm trocars were inserted in the left lower and mid quadrants. Upon freeing the mesentery, a single staple at the free end of the staple line was found hooked on the mesentery of an adjacent loop of small bowel, creating an unusual space through which an internal hernia resulted (Figs. 2 and 3). The offending staple was removed, relieving the obstruction. The appendiceal stump was inspected and found to have no disruptions. The small bowel was edematous, but non-ischemic. Recovery was unremarkable and the patient was subsequently discharged on the following day.

3. Discussion

Acute appendicitis is the most common urgent operation in general surgery, and both open and laparoscopic approaches have been described in the literature [3,4]. Since its first description in 1983 by Seem, laparoscopic appendectomy has been demonstrated to be safe and effective. [5,6] Compared with the open approach, laparoscopic appendectomy offers the well known advantages of minimally invasive surgery, such as reduced wound infection, early recovery, decreased scarring, improved cosmesis, shorter hospital stay, and reduced postoperative pain [7].

Nevertheless, the laparoscopic approach has several disadvantages such as the increased complexity of the procedure, increased operative time, and the use of disposable instrumentation that increases procedural cost. As with open appendectomy, stump leak, intra-abdominal abscess formation, or small bowel obstruction can occur [8].

In order to optimize the laparoscopic approach, different ways to close the stump were developed, including clips, endoloops, and staplers to divide the appendix. The quality of the tissue and the stage of appendicitis, as well as surgeon's preference, dictate which system is most optimal [9]. Different materials may vary in terms of inflammation, foreign body reaction, or rate of infection in the surgical area. Clips are easy to apply and economical, but are only preferred when the appendicular base is small. Endoloops are

Fig. 1. CT scan showing distal small bowel obstruction with transition point highlighted by the arrow.

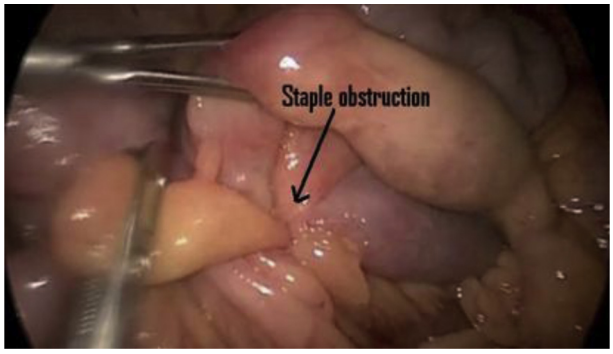

Fig. 2. Mesenteric adhesions derived from the staple line.

accepted worldwide as a cost-effective alternative to close the appendiceal stump, but are associated with higher rates of abdominal cavity abscess because of the exposed mucosa [10]. The introduction of endoscopic staplers has resulted in less wound infection, reduction in postoperative ileus, and less foreign body giant cell reaction as seen in randomized control trials [11]. This is likely because of the hermetic closure of the appendical stump when the tissue comprising the base is friable and edematous [12]. The use of stapling devices has simplified the steps involved in dividing the appendix. It has decreased the complexity and the operative time, allowing surgeons with variable levels of training to safely perform the procedure. Although the cost of stapling devices is significantly higher than the cost of endoloops, the reduction of anesthesia and surgical time has made their utilization cost effective [13].

Although reports of complications related to staples are rare, they have been reported. Occasionally, there can be bleeding of the staple line or bowel obstruction from retained staples. The presence of loose staples is common because of disparity in size between the tissue being stapled and the staple load length. These loose staples in the abdominal cavity are generally considered innocuous and inconsequential, but complications have been reported [14]. Further, the edges of the staple line can have unformed staples that are fixed at one end, but free at the other. The free end can get hooked on other structures and cause rare complications [15]. In this paper, we have described an internal hernia due to one unformed staple. To avoid these problems, unformed and loose staples should be removed and, whenever possible, the staple line should be covered with omentum. As the use of stapling devices has become more prevalent not just in appendectomy, but in many

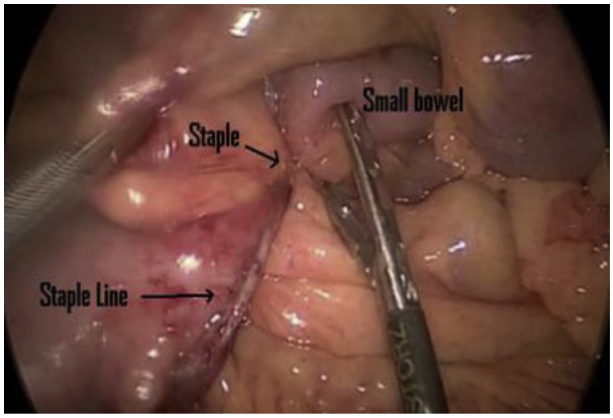

Fig. 3. Internal hernia through the space created by a loose staple and the small bowl.

other surgical procedures, surgeons should always be mindful of these complications.

It is important to consider that laparoscopic appendectomy for non-perforated appendicitis should not result in significant ileus. The presence of abdominal pain and abdominal distention one week after surgery should raise the suspicion for intrabdominal pathology and not postoperative ileus [16]. In this case, based on the overall clinical picture, supported by the laboratory derangements (leukocytosis and metabolic acidosis) and the distal small bowel obstruction on CT scan, prompt operative intervention was necessary. Continued non-operative observation would have likely resolved in the development of irreversible bowel ischemia.

4. Conclusions

Staple devices are frequently used for appendiceal stump closure. Occasionally they can cause unexpected complications. The staple line should be inspected at the end of the procedure to ensure that there are no free unformed staple edges. Early bowel obstruction after routine abdominal surgery should be closely investigated and might warrant early re-exploration.

Ethical approval

This is a retrospective study based only on the analyses of recorded data and no Ethical approval was necessary.

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Author contribution

Meenakshi Rajan: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

Fernando Dip: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

Samuel Szomstein: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

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Conflict of interest

All authors have no conflict of interests.

References

[1] D.D. Bensard, R.J. Hendrickson, C.J. Fyffe, J.M. Careskey, R.G. Azizkhan, Early discharge following laparoscopic appendectomy in children utilizing an evidence-based clinical pathway, J. Laparoendosc. Adv. Surg. Tech. A. 19 (Suppl. 1) (2009) S81–S86.
[2] K.K. Yau, W.T. Siu, C.N. Tang, G.P. Yang, M.K. Li, Laparoscopic versus open appendectomy for complicated appendicitis, J. Am. Coll. Surg. 205 (1) (2007) 60–65.
[3] A. Rashid, S. Nazir, S.M. Kakroo, M. Chalkoo, S. Razvi, A. Wani, Laparoscopic interval appendectomy versus open interval appendectomy: a prospective randomized controlled trial, Surg. Laparosc. Endosc. Percutan Tech. 23 (1) (2013) 93–96.
[4] M.M. Tiwari, J.F. Reynoso, A.W. Tsang, D. Oleynikov, Comparison of outcomes of laparoscopic and open appendectomy in management of uncomplicated and complicated apendicitis, Ann. Surg. 254 (6) (2011 Dec) 927–932.
[5] K. Semm, Endoscopic appendectomy, Endoscopy 15 (2) (1983) 59–64.
[6] C. Esposito, P. Borzi, J.S. Valla, M. Mekki, A. Nouri, F. Becmeur, et al., Laparoscopic versus open appendectomy in children: a retrospective comparative study of 2,332 cases, World J. Surg. 31 (4) (2007) 750–755.
[7] M.I. Aziz, B.L.S.B. Van Der Burg, J.F. Hamming, Laparoscopic versus open appendectomy in children: a metaanalysis, Ann. Surg. 186 (3) (2008) 545–553.
[8] A. Kwiatkowski, K. Paśnik, P. Trojanowski, Late caecal fistula after laparoscopic appendectomy managed mini-invasively – case report, Wideochir Inne Tech. Malo Inwazyjne. 6 (4) (2011) 246–248.
[9] A. Safavi, M. Langer, E.D. Skarsgard, Endoloop versus endostapler closure of the appendiceal stump in pediatric laparoscopic appendectomy, Can. J. Surg. 55 (1) (2012) 37–40.
[10] C.A. Gomes, T.A. Nunes, C. Soares Jr., et al., The appendiceal stump closure during laparoscopy: historical, surgical, and future perspectives, Surg. Laparosc. Endosc. Percutan Tech. 22 (2012) 1–4.
[11] M. Sahm, R. Kube, S. Schmidt, C. Ritter, M. Pross, H. Lippert, Current analysis of endoloops in appendiceal stump closure, Surg. Endosc. 25 (1) (2011) 124–129.
[12] G. Kazemier, K.H. In't Hof, S. Saad, H.J. Bonjer, S. Sauerland, Securing the appendiceal stump in laparoscopic appendectomy: evidence for routine stapling? Surg. Endosc. 20 (9) (2006) 1473–1476.
[13] G.D.M. Beldi, S.D.P. Bisch-knaden, V. Banz, K. Mühlemann, et al., Impact of intraoperative behavior on surgical site infections, Am. J. Surg. 198 (2) (2009) 157–162.
[14] A.M. Merhoff, G.C. Merhoff, M.E. Franklin Jr., Laparoscopic versus open appendectomy, Am. J. Surg. 179 (5) (2000) 375–378.
[15] J.M. Nottingham, Mechanical small bowel obstruction from a loose linear cutter staple after LA, Surg. Laparosc. Endosc. Percutan Tech. 12 (2002) 289–290.
[16] A. Cavallaro, V. Catania, M. Cavallaro, A. Zanghì, A. Cappellani, Management of secondary peritonitis, Ann. Ital. Chir. 79 (4) (2008) 255–260.